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ELASMOBRANCHI COME SENTINELLE DEL CAMBIAMENTO AMBIENTALE NEL MAR MEDITERRANEO

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Abstract

Elasmobranchs, sharks and rays, are key components of marine ecosystems, acting as both apex predators, mesopredators and benthic consumers that contribute to maintaining ecological balance. In the Mediterranean Sea, one of the most anthropogenically impacted basins in the world, these species are exposed to multiple anthropogenic pressures, most notably overfishing and chemical contamination.

Despite their ecological importance, fundamental aspects of their ecology and toxicological vulnerability remain poorly understood in this region. In particular, little is known about how habitat use, movement patterns and trophic behavior influence contaminant exposure across species with different ecological niches. Addressing these gaps is essential for assessing their conservation status and for understanding how environmental change affects top and mid-level predators in the Mediterranean.

This study explored their ecological behavior and exposure to trace elements through an integrated approach that combines satellite tracking and ecotoxicological analyses of muscle tissues to link movement ecology with contaminant exposure and provide a more comprehensive understanding of species–environment interactions.

For the trace-element component, six species with different ecological habits were examined. The results reveal clear interspecific differences in trace element accumulation, closely related to habitat use and trophic level.
The benthic skate rough ray (*Raja radula*) showed the highest concentrations of sediment-related elements like arsenic (As), iron (Fe) and strontium (Sr), while demersal species such as smooth-hounds (*Mustelus* sp.), the common stingray (*Dasyatis Pastinaca*) and the common eagle ray (*Myliobatis aquila*) exhibited intermediate values.

The pelagic thresher shark (*Alopias vulpinus*) had the lowest concentrations, reflecting its limited contact with the seabed. Overall, As and Fe were the most abundant elements, although all concentrations remained below current European food safety limits.

Satellite tracking, instead, was performed on three additional species, providing new insights into the spatial ecology of Mediterranean sharks. The blue shark (*Prionace glauca*) displayed both resident and vertically migratory behavior, while the pelagic stingray (*Pteroplatytrygon violacea*) remained mostly in surface waters with occasional nocturnal dives.

The most remarkable result was recorded for the shortfin mako (*Isurus oxyrinchus*), which traveled nearly 2000 km from the waters off Cyprus to the central Adriatic, the longest horizontal displacement documented in this study.
This large-scale movement confirms that, even within a semi-enclosed sea, mako sharks maintain the wide-ranging strategies typical of oceanic populations.

By integrating ecological and ecotoxicological perspectives, this study provides a more comprehensive understanding of how Mediterranean elasmobranchs interact with their environment and respond to human-driven pressures.
The findings highlight their role as sentinels of environmental change and emphasize the importance of long-term, multidisciplinary monitoring to support their conservation and the health of the ecosystems they inhabit.